WR3500-UM-151

INSTRUCTION MANUAL
for
LINEARCORDER MARK VIII
WR3500

WESTERN GRAPHTEC

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We would like to express our appreciation for your purchase of the WR3500 Linearcorder Mark 8.

To ensure that you get the most out of your new recorder, we recommend that you read this manual carefully before use.

Outline

The WR3500 is a pen oscillograph capable of recording up to eight channels. It features a recording width of 40mm (or 80mm) and uses high-speed pen motors for fast response.

Features

- Vertical Operation

  Operating in a vertical attitude, the WR3500 takes up a minimum of desktop space and is also ideally suited to rack mounting.

- High Response Speed Recording (Response up to 140Hz)

- A Printer is provided as a standard feature, enabling character data to be recorded as well.

The WR3500 consists of two sections, the mainframe and the amplifier box. This manual devotes separate chapters to each of these sections, as follows.

Section 1 Mainframe
Section 2 Amp Box
Section 3 Specifications

In addition to the desktop version of the WR3500 which has a unitized construction including the mainframe and the amp box, rack-mount versions with separate sections are available. Refer to the corresponding sections.

Before Using the WR3500

Unpacking

After unpacking the WR3500, inspect the appearance of the recorder and verify that all the required accessories have been received, referring to the table in Section 3.2. Should damage or a shortage be noted, consult your local sales representative.

Installation Location

The WR3500 is used in a normal indoor environment in a vertical position.

- Avoid locations subject to excessive dust, dirt, salt and corrosive gases.
- Avoid using the recorder in locations with temperatures or humidities outside the specified ranges.
- Avoid using the recorder in locations subject to direct sunlight.
- Avoid using the recorder in locations subject to excessive vibration and shock.
- Avoid using the recorder in locations which would subject the recorder to surge voltages such as those resulting from lightning and electromagnetic interference.

Power Supply

The WR3500 should be powered from an AC line of the specified line voltage (and capacity). The line should have a protective ground.

CAUTION

To enable operation at line voltages other than 100V, the WR3500 features a line voltage selector on its rear panel. Before performing any operations with the WR3500, always check that this line voltage selector has been set properly.

Recording Paper

This recorder uses thermal recording paper. The coloration characteristics, surface smoothness and other characteristics of the thermal recording paper have a great influence on the quality of recorded traces. Always use Graphtec recording paper.

Recording Pens

Do not touch the pens except when changing them. Do not set the pen pressure excessively low or float the pen off the recording paper, as this can damage the pens.

Notes on Data Storage

The recording paper used with the WR3500 makes use of a thermal reaction to record data. The following points should be observed, therefore, when handling recorded data.

- Do not store recordings where they will be subjected to direct sunlight.
- Do not store recordings at temperatures of 50°C or above.

- Store in a location as free as possible from light. Subjecting the recordings to exposure from fluorescent or natural lighting will cause a loss of recorded contrast after several months.
- Do not store recordings in PVC bags.
- Do not allow wet diazo paper to come into contact with the recordings.
- Do not allow the recordings to come into contact with acids, alcohol or ester ketone.

Pen Protection Functions

To protect the pen tips, the following pen-protection functions have been provided.

- Whenever the recording paper has run out, the pen heat is switched off and the pens are stopped.
- When the STOP button is pressed and the recording paper stops, the pen heat is switched off and the pens are stopped.
- When the pen lifting lever is pressed to raise the pens off of the paper, the pen heat is switched off and the pens are stopped.

Mounting the Recording Paper

Always mount recording paper after verifying that the pen HEAT switch is OFF.

Alarm Beeper

An alarm beeper sounds, the pen heat is switched off and pen motion is stopped whenever the following occurs.

- When recording paper has run out.

o When the pen lifting lever is pressed to float the pens off of the paper.

Should the beeper sound, be sure to press the white STOP button before performing the next operation.

High-Frequency Input

The servo system accuracy is guaranteed as long as the servo amplifiers remain unsaturated. Care is required, therefore, to ensure that a high-frequency input exceeding the pen response speed is not applied.

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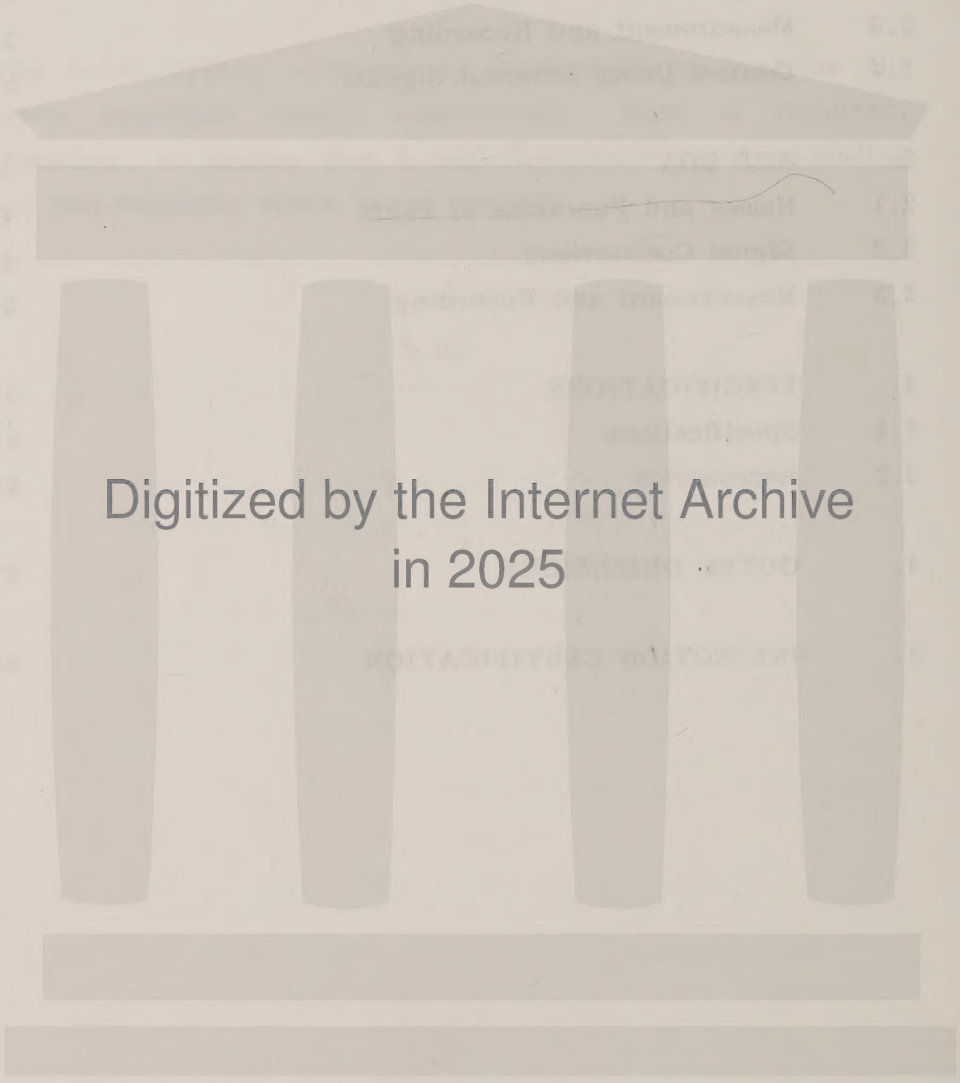

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1. MAINFRAME

1.1 Names and Functions of Parts

1.1.1 Mainframe Photograph

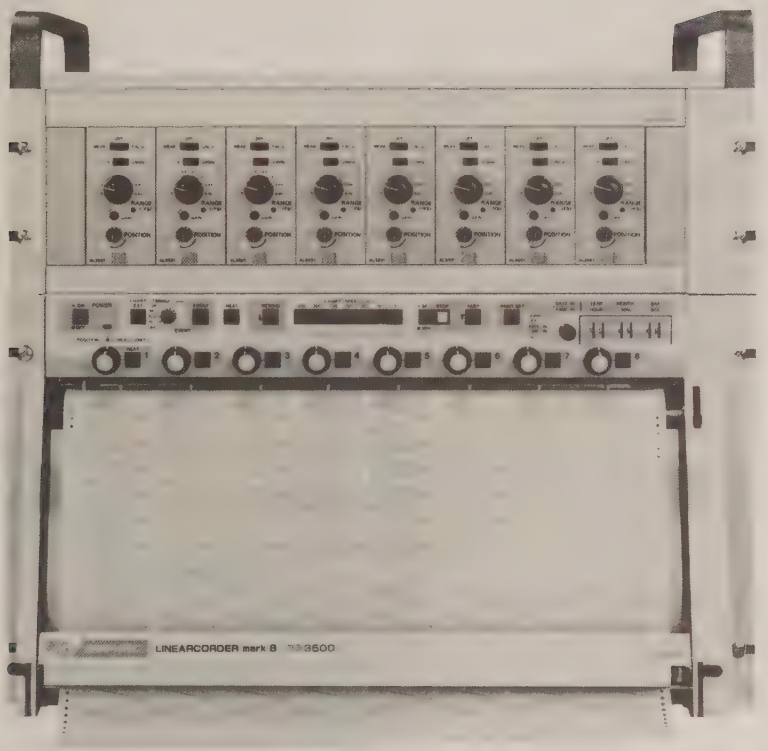


Fig. 1-1 Top view

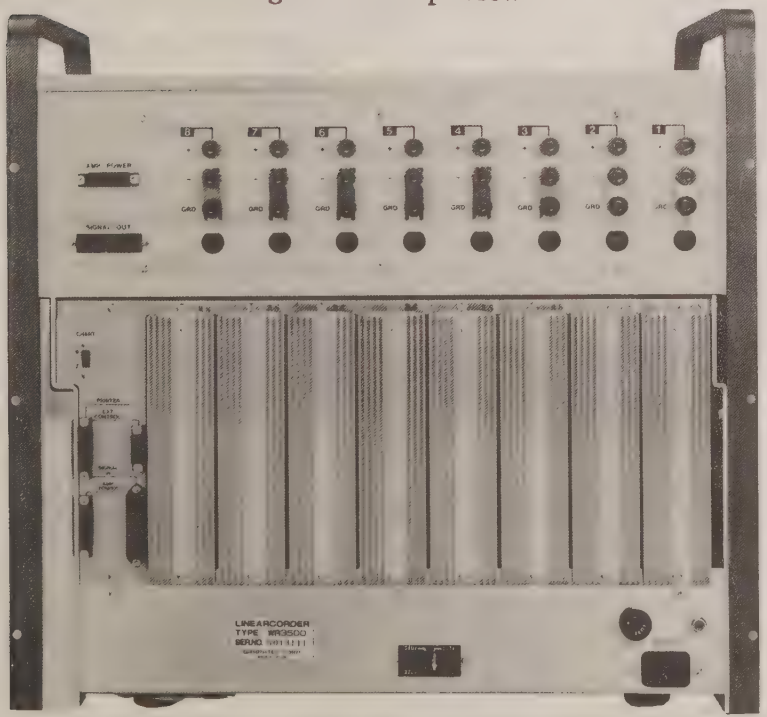
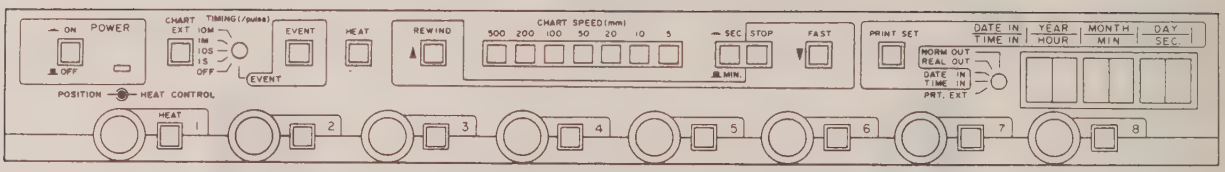
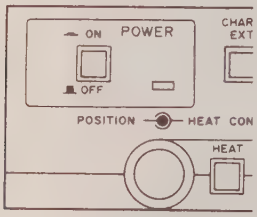


Fig. 1-2 Rear view

1.1.2 Front Panel Description





POWER

This switch turns the WR3500 power ON and OFF. When pressed to lock it in the in position, the power is applied and the pilot lamp to the right of the switch lights. Pressing it once again turns the power OFF.

> CAUTION
>
> When applying power, verify the following items first.

1 Verify that the line voltage selector on the rear panel has been set to the proper line voltage.

2 Be sure to press the STOP switch first.

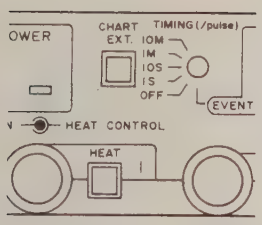
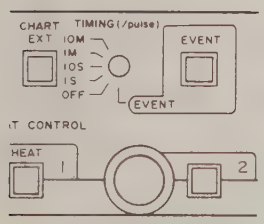


CHART EXT

This is the recording paper feed selection switch. When pressed to lock it in the in position, feed is synchronized to an external pulse signal. When pressed once again to release the lock, the front panel CHART SPEED switch controls the feed speed.

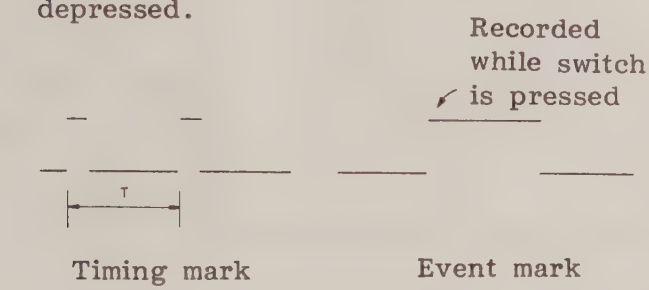


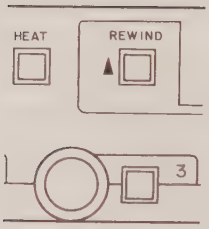
TIMING

This switch selects the marker pen recorder timing. The timing signal interval may be set in the range 1s ∿ 10min. When this switch is set to OFF, the timing signal is not recorded.

EVENT

This switch is used to record an event mark using the marker pen. It operates only when the TIMING switch is in the EVENT position. The mark is recorded as long as the switch is kept depressed.



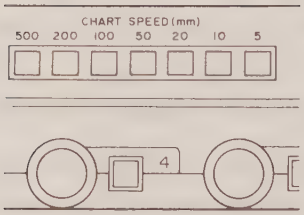


HEAT

This switch is used to turn off the heat of all the recording pens. When pressed to lock it in the in position, pen heat will be applied if other switches are set to satisfy recording conditions.

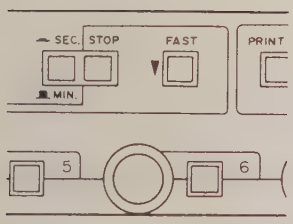
REWIND

This switch is used to rewind the recording paper. This is used only with roll-type recording paper and is only operative when the operating section STOP switch has been depressed. When the REWIND switch is pressed, recording is interrupted and the recording paper rewinds at a speed of approximately 100mm/s.



SPEED

These are the recording paper feed speed selection switches. They are operative when the operating section CHART EXT. switch has been pressed in. Seven steps of chart speed in the range 5 ∿ 500 may be selected. If no switch has been pressed, the speed used will be as if the No. 5 switch had been pressed.



SEC/MIN

This switch is used to select the units for the recording paper feed speed. When pressed to lock it in the in position, the recording paper speed is mm/s. If pressed once again to release the switch lock, the units are mm/min.

STOP

This switch is used to stop the recording paper feed. When pressed to lock it in the in position, paper feed stops. Pressing it once again to release the lock starts paper feed once again at the set speed.

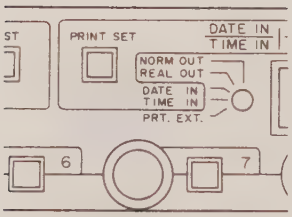
FAST

This is the recording paper fast-feed switch. Recording paper is fed at high-speed while this switch is depressed.

PRINT SET

This switch is used to write the date and time data using the printer. The data is written by an internal CPU when the switch is depressed.

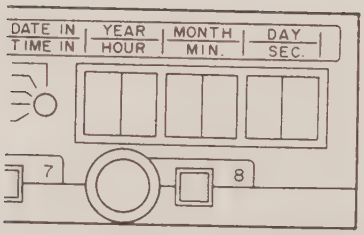
This switch is used in combination with the mode and thumbwheel switches.



NORM OUT

This is the printer mode selection switch.

NORM OUT	Automatic printing of elapsed time.
REAL OUT	Automatic printing of time and date.
DATE IN	Date (year/month/day) setting
TIME IN	Time (hour/minute/second) setting
PRT EXT	Recording of externally input character information

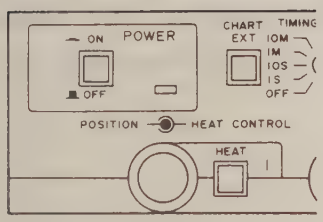


Thumbwheel Switches

These switches are used to set data values to be written by the printer. Six digit switches are used to set the year/month/day or hour/minute/second.

POSITION

This is the pen zero-point adjustment trimmer. It is part of a dual trimmer linked to the heat control. The position control is the small (inner) knob.



HEAT CONTROL

This trimmer adjusts the recording density. It is the larger (outer) knob. Turning the adjustment CW increases the recorded density.

HEAT

These are individual heat switches for each recording pen. When a switch is pressed to lock it in the in position, the corresponding pen is powered (i.e., heat is applied), the recording signal is connected and the pen is deflected.

When the switch is pressed once again to release the lock, the pen heat is switched off, the recording signal is disconnected and recording is interrupted.

1.1.3 Recording Section

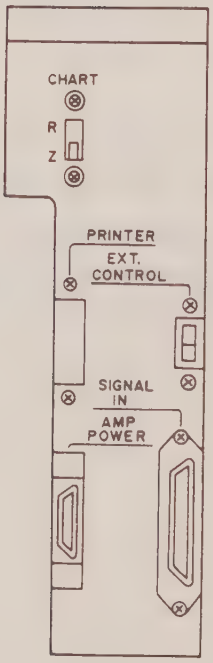
(a) Pen Lift Lever

This lever raises the recording pens off of the recording paper. It is used when mounting recording paper. When the lever is lifted, the pens are lifted off the paper. If the feed stop condition is cancelled with this lever remaining in the upper position, an alarm beeper sounds and pen deflection and recording will not be performed.

(b) Pinch Roller Lever

This lever is used to move the pinch roller which feeds the recording paper. It is used when recording paper is mounted. When the lever is lowered, the pinch roller moves. After mounting recording paper, this lever is raised.

1.1.4 Rear Panel Description



CHART

This is the recording paper selection switch. Two types of recording paper, roll and Z-fold paper may be used. When using roll-type paper, this switch is set to R and when using Z-fold paper, the switch is set to Z.

CAUTION

The following operations are switched by means of the CHART switch.

- In the R position, the roll-paper rewind operates and for Z-fold paper, the paper is fed at a fixed high-speed of 100, 200 or 500mm/s.

- In the Z position, paper rewind does not operate.

PRINTER

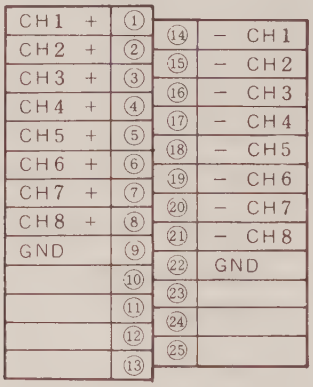
This connector is used to make connection to an external printer signal. It can be used to print externally applied characters.

EXT. CONTROL

This connector is used to apply external signals used to control the WR3500. It can be used with internal signals to control recording paper feed, pen heat and the event marker.

SIGNAL IN

This connector is used to apply the signals which are recorded. Connections are as follows.



CH1 is the leftmost channel with the recorder viewed from the front. When using the amp box, an accessory cable is used to make connection to the amp box. With this type of operation, signals to be recorded are connected at the amp box.

AMP. POWER

This is the amp unit power supply output connector. it is connected to the Amp Box by means of a special accessory cable provided for this purpose.

AC SOURCE

This is the AC power connector. It is a three-pin connector with a protective conductor.

GND

This is a protective ground terminal which is connected to the protective conductor of the AC line power connector.

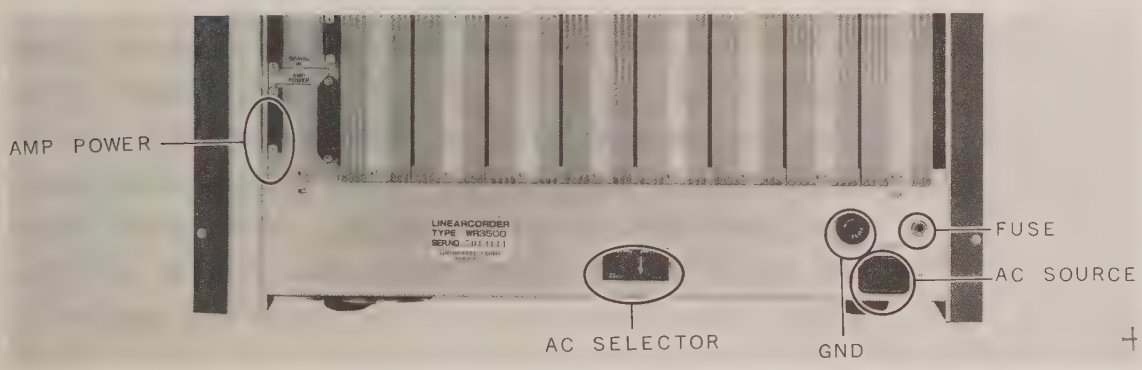
FUSE

This is the AC power supply fuse. The fuse rating will depend upon the line voltage used, as follows.

100V and 117V Lines	6A
220V and 240V Lines	3A

AC SELECTOR

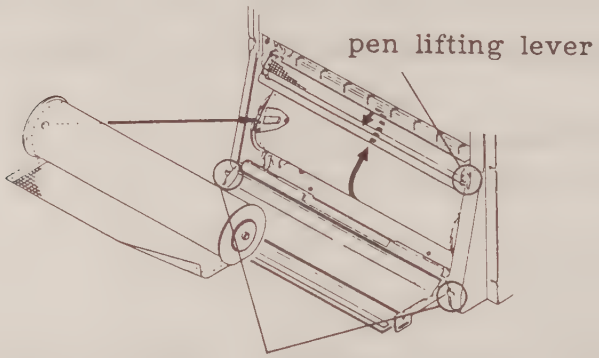
This selector enables selection of the line voltage. Align and insert with the central white arrow at the desired value.



1.2 Preparation for Measurement

1.2.1 Mounting Roll-Type Paper

When mounting recording paper, always press the STOP switch first. Paper is mounted by following the procedure below.



1 Open the recording panel towards the front and pull the stock roller located inside out towards the front.

2 Turn the stock roller flange that has no gear counterclockwise and remove. Next, insert the recording paper over the stock roller from the side of the core which has a groove. Align the recording paper core groove with the protruding part of the stock roller and verify that the paper is in close contact with the flange. Next, screw on the flange which was removed.

3 Push the stock roller into the recorder. This is done with the side having the gear at the right and the roller should be pushed in until it stops.

4 Raise the pen lifting lever located at the upper right of the recording panel to lift the pens.

5 Run the recording paper edge over the recording paper guide plate and insert it upward through the space and feed out.

6 When the paper protrudes through the space between the sprocket roller and the pen tips, pull it out manually. Align the holes in the paper with the sprocket teeth. The left side sprocket may be moved to the left and right to adjust for the paper width. When doing this, align the paper so that the scale line on the recording paper is parallel to the pens. To achieve this condition, align the sprocket teeth and holes and turn the sprocket in the direction that returns the paper.

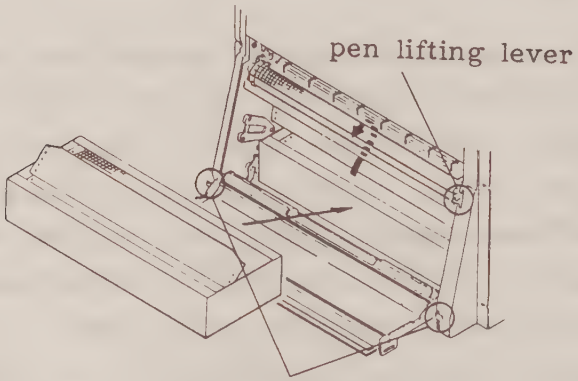
7 Lower the pen lifting lever and close the recording panel.

8 Lower the pinch roller lever and, after passing the paper through the space between the pinch roller and feed roller, lift the pinch roller lever to set the pinch roller.

9 Set the CHART switch at the rear of the recorder to the R position.

1.2.2 Mounting Z-Fold Paper

When mounting recording paper, always press the STOP switch first. Paper is mounted by following the procedure below.



1 Open the recording panel towards the front and pull the stock roller located inside out towards the front. Since the stock roller is not used, store this separately.

2 Open the top cover of the recording paper box. Pull out a small amount of paper and mount the entire paper end box in the recorder. (When doing this, position the box so that the side of the paper with higher channel numbers is at the right.)

3 Raise the pen lifting lever located at the upper right of the recording panel to lift the pens.

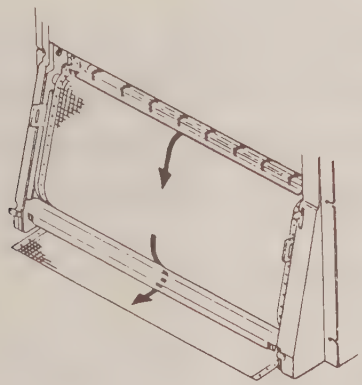
4 Run the recording paper edge over the recording paper guide plate and insert it upward through the space and feed out.

5 When the paper protrudes through the space between the sprocket roller and the pen tips, pull it out manually. Align the holes in the paper with the

sprocket teeth. The left side sprocket may be moved to the left and right to adjust for the paper width. When doing this, align the paper so that the scale line on the recording paper is parallel to the pens. To achieve this condition, align the sprocket teeth and holes and turn the sprocket in the direction that returns the paper.

6 Lower the pen lifting lever and close the recording panel.

7 Lower the pinch roller lever and, after passing the paper through the space between the pinch roller and feed roller, lift the pinch roller lever to set the pinch roller.



8 Set the CHART switch at the rear of the recorder to the Z position.

1.2.3 Power Supply Connection

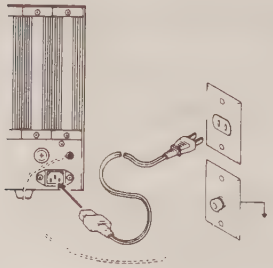
(a) Preparation

Make the following switch settings.

1 POWER Switched to OFF.
2 CHART EXT. Switched to OFF.

3 HEAT Switches to OFF.

4 STOP Switch to STOP.



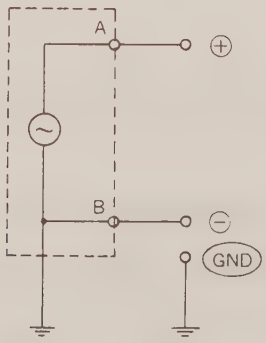
Straight type

(b) Connection

Insert the accessory power cable into the AC SOURCE connector. If the line power used does not have a protective ground conductor, connect the protective ground terminal to ground.

1.2.4 Signal Input Connections

Input signals for all eight channels are applied at a single connector. Solder the input lines to the accessory connector provided. Channels are mutually floating. When using an Amp Box, make connection to the Amp Box using the special accessory cable provided and make signal input connections at the Amp Box.



(a) Inspection

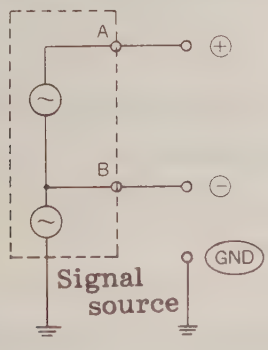
When making signal line connections, care should be taken with the following.

1 The input sensitivity is 5V, full scale. Input of signals greater than this level will cause the pens to pin.

2 Care should be taken that the voltage applied between a signal input pin and a ground pin (GND) does not exceed 500V.

(b) Connection

Signal connections should be made depending upon the nature of the signal source. For normal signal sources, connections should be made as shown at (A), and for floating signal sources, connections should be made as shown at (B).



See Section 1.1.4 for the signal input connector pin arrangement.

1.3 Measurement and Recording

1.3.1 Input Waveform Recording

Input waveform measurement and recording are performed by following the procedure below.

(a) Checks to Be Made Before Applying Power

Before applying power, make the following checks.

- o Verify that the line voltage selector is set to the proper line voltage.
- o Set the HEAT switches to OFF (i.e., not depressed).
- o Set the STOP switch to STOP (depressed condition).
- o Set the CHART EXT. switch to OFF (i.e., not depressed).
- o Check that the power cable and signal cable are properly connected.

(b) Application of Power

Press the POWER switch of the operating section to lock it in the in position. This applies power to the WR3500 and is indicated by the pilot lamp to the right of the switch lighting.

(c) Setting the Recording Paper Feed Speed

Set the recording paper feed speed using the CHART SPEED switches to a speed which is appropriate to the signal to be measured and recorded.

(d) Zero-Point Setting

Press the STOP switch to release its lock and feed the recording paper. With the HEAT switches of all channels released (i.e., not depressed), turn the POSITION adjustments to set the pen zero positions.

(e) Starting Measurement and Recording

When the above preparation has been completed, press the HEAT switch of each channel to be recorded to lock them in the in position. In this condition, the measurement signals will be used to deflect the pens. When the recorder's HEAT switch is pressed, pens will be powered and recording will start.

1.3.2 Marker Recording

One marker pen is provided. This pen is switched between the timing mark signal and the event mark signal.

(a) Timing Mark Recording

Set the TIMING switch in the range 1S 10M. A timing mark will be recorded at the left edge of the recording paper at the set timing interval.

(b) Event Mark Recording

Set the TIMING switch to the EVENT position. A mark will be recorded whenever the EVENT button is pressed.

1.3.3 Printer Recording

A printing head is used to record character information.

This recording can be performed in the internal mode (automatic recording of internal data) or in the external mode (recording of character information input from an external digital device). This section describes the internal mode. For information on the external mode, see Section 1.4.7.

The internal mode has two sub-modes, normal and real.

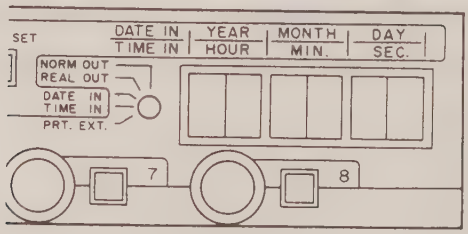
(a) Normal Mode (NORM OUT)

In the normal mode, automatic recording of the date, elapsed time and recording paper feed speed is performed.

The elapsed time is taken with 00:00:00 as the time when power is applied and is the accumulated elapsed time since power is first applied. If this time exceeds 24 hours, return is made to 00:00:00 and accumulation of time begins. Note that the date is not advanced.

(b) Procedure

1 Set the printer mode switch to NORM. OUT.



2 Set the thumbwheel switches to the year, month and day (starting from the left for two digits for each value). The set data will be printed as is in the form of character information, as follows.

(Example) January 1, 1985

YEAR		MONTH		DAY	
8	5	0	1	0	1

3 Set the POWER switch to ON (depressed condition).

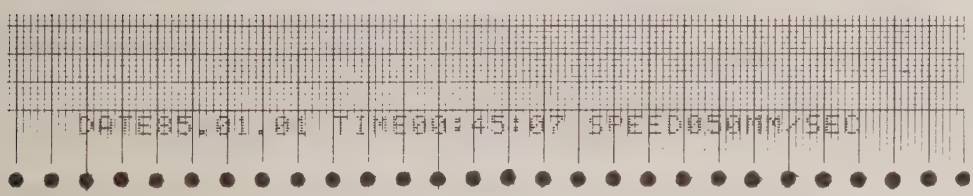
4 Set the recording paper feed speed.

5 Set the HEAT switch to ON (depressed condition), press the STOP switch to release its lock and recording paper feed will start as characters are recorded.

Printing of these characters is repeated at approximately every 450mm of recording paper.

(Example)

At a feed speed of 50mm/s, the following recording will be made at every 45 minutes after power is applied.



CAUTION

- The data recorded is the data that was valid immediately prior to the start of recording.

- If the thumbwheel switches are used to change the data during recording or if the recording paper feed speed is changed during recording, the recorded characters will not change. These will be updated, however, the next time the character print is made.

- When externally synced recording paper feed speed is used (i.e., when the CHART EXT. switch is depressed), EXTERNAL will be recorded instead of the feed speed.

- Character recording is made only when the recording paper is being fed and the HEAT switch is depressed.

- It should be remembered that the computer used to control the printer is cleared (reset) when the power is switched OFF.

(c) Real Mode (REAL OUT)

In the real mode, automatic recording of the date, time and recording paper feed speed is performed.

The time is the value of an internal clock, which requires initial setting.

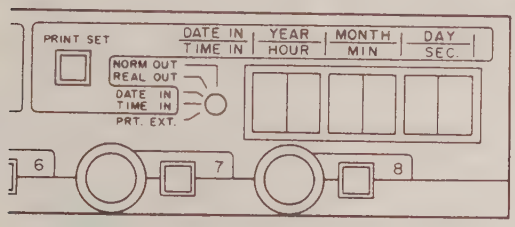
When the time reaches 24 hours, the date is automatically advanced. Note that the internal clock runs continuously, even when the power is OFF, this being powered by a back-up battery.

(d) Procedure

1 Press the STOP switch.

2 Set the POWER switch to ON.

3 Set the printer mode switch to TIME IN.



4 Set the thumbwheel switches to the hour, minute and second (from the left, with two digits for each value). The time is set based on a 24-hour clock.

(Example) 13:15:00

HOUR		MIN		SEC	
1	3	1	5	0	0

5 Press the PRINT SET switch. When this is done, data is written into the control computer and accumulation of the time begins.

6 Set the printer data switch to DATE IN.

7 Set the thumbwheel switches to the year, month and day (starting from the left, with two digits for each value). The year data is set as the last two digits and this is automatically compensated for leap years.

(Example) March 1, 1985

YEAR		MONTH		DAY	
8	5	0	3	0	1

8 Press the PRINT SET switch. When this is done, data will be written into the control computer.

9 Set the printer mode switch to REAL OUT.

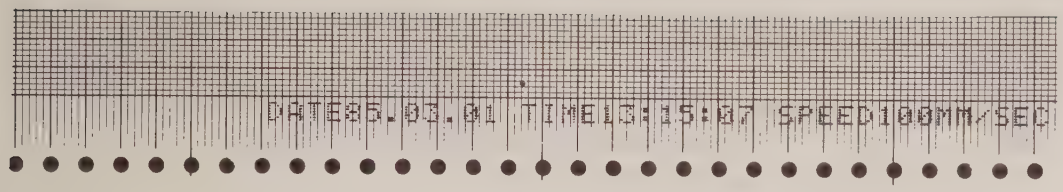
10 Set the recording paper feed speed.

11 Set the HEAT switch ON, press the STOP switch to release the lock and recording paper will begin feeding as characters are printed.

Character recording will be made at approximately every 450mm of recording paper and repeated at this interval.

(Example)

At a feed speed of 100mm/s, the following type of character recording will be made.



12 When recording of signals is completed, set the POWER switch to OFF.

13 To perform recording again, set the printer mode switch to REAL OUT and then switch the POWER to ON. After this, start at step 10 above. Since the date and time were backed up, these will be automatically recorded as the correct values.

14 To change the date and time, set the HEAT switch to OFF or set the STOP switch to STOP and then begin at step 3 above. It is also possible to change either one of these settings.

CAUTION

- The data recorded is the data that was valid immediately prior to the start of recording.
- When externally synced recording paper feed speed is used (i.e., when the CHART EXT. switch is depressed), EXTERNAL will be recorded instead of the feed speed.
- Character recording is made only when the recording paper is being fed and the HEAT switch is depressed.

- The year data is the last two digits of the year with automatic correction made for leap years.

- If impossible settings for the month and day are made, the following will occur.

  - For settings up to the 31st day (Ex.: Feb. 30), after reaching the 31st day, reset is made to the 1st of the next month.

  - For a setting of the 32nd day or thereafter (Ex.: Feb. 35), data is ignored and the clock is not updated.

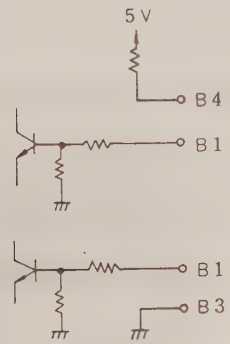
- If an impossible time is set (Ex.: 13:65), data is ignored and the clock is not updated.

1.4 Control Using External Signals

External control signals may be used to control the operation of the WR3500.

1.4.1 Recording Paper Feed Stop (CHR. STP)

An external control signal may be used to stop the recording paper feed. To use this control function, the panel STOP switch should be set to OFF.



(a) Contact Signal

Connect a switch between pins (B1) and (B4) of the control connector.

ON: Feed stop
OFF: Feed start

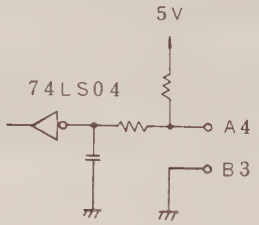
(b) TTL Level Signal

Input a signal between pins (B1) and (B3) of the control connector.

L: Feed start
H: Feed stop

1.4.2 Recording Paper Feed External Synchronization (CHR. CLK)

Recording paper feed may be synchronized to an external signal. To use this control function, set the CHART EXT. switch to EXT.



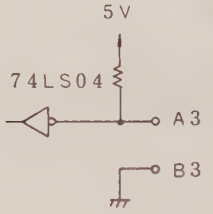
Contact or Open-Collector TTL Level Signal

Input a signal between pins (A4) and (B3) of the control connector. Each time high (OFF) and low (ON) are repeated, the recording paper will feed 0.025mm.

Maximum frequency	2000pps (2000 times per second)
Pulse width	10μs
Amount of feed	0.025mm/pulse

1.4.3 Recording On/Off (HEAT. ON)

An external signal may be used to turn the recording function (i.e., heat) on and off. To use this control function, set the HEAT switch to off.



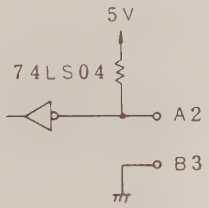
Contact or Open-Collector TTL Level Signal

Input a signal between pins (A3) and (B3) of the control connector.

L (ON): Recording (pens heated)
H (OFF): No recording (pens turned off)

1.4.4 Event Marker (EVENT)

An event marker may be recorded under the control of an external signal. To use this control function, set the TIMING switch to EVENT.



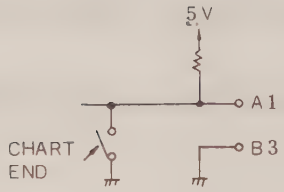
Contact or Open-Collector TTL Level Signal

Input a signal between pins (A2) and (B3) of the control connector.

L (ON): Event marker recorded
H (OFF): Event baseline recorded

1.4.5 Recording Paper End Signal Output (CHR. END)

A control signal indicating that there is no recording paper left or that the pens are up is output at pins (A1) and (B3) of the control connector.



L: No remaining paper or pens are up (i.e., recording is not possible).

H: Paper remaining and pens are down (i.e., recording is possible).

1.4.6 Timing Signal Output (TIM. OUT)

When a timing mark is recorded, the corresponding signal is output. This can be connected to the timing markers of other recorders and can, thus, serve as a reference for analysis of recordings. The signal is output between pins (B2) and (B3).

L: Timing mark

H: Timing mark baseline

1.4.7 Printer (External Mode A)

The printer can be used to record character data from an external digital device.

Recording of character information from an external device can be done by recording character data as is during an internal mode recording (external mode A) or by selecting either internal mode information or externally applied character data, using a command (external mode B).

(a) External Mode A Operation

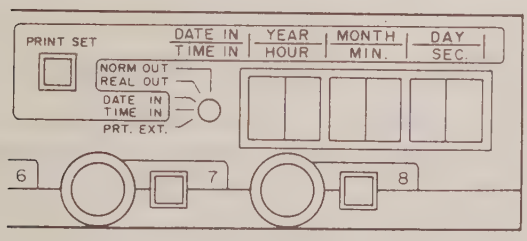
After recording internal data in the normal mode or real mode format, character signals received from an external device are recorded.

CAUTION

- Using external mode A operation, character signals (ASCII codes) from an external device are recorded as received.
- Signals from an external device are not accepted during internal mode printing.

(b) External Mode A Setting Method

Set the printer mode switch to NORM OUT or REAL OUT.



(c) Character Signal Length and Character Recording

1 11 or fewer characters + terminator

Recording is made of characters up to and including the terminator.

2 13 or more characters + terminator

After 12 characters of data are entered into buffer memory, 12 characters are recorded, after which the next 12 characters of data are received. This is repeated until the terminator is received.

3 11 Characters or fewer only

Data is entered into buffer memory but recording is not made. Internal data is not recorded either.

4 13 Characters or greater only

After 12 characters of data are entered into buffer memory, 12 characters are recorded and the remaining data is entered into memory. Recording is made each time the buffer contents reach 12 characters. For 11 or fewer characters, recording is not performed and internal data is not recorded either.

CAUTION

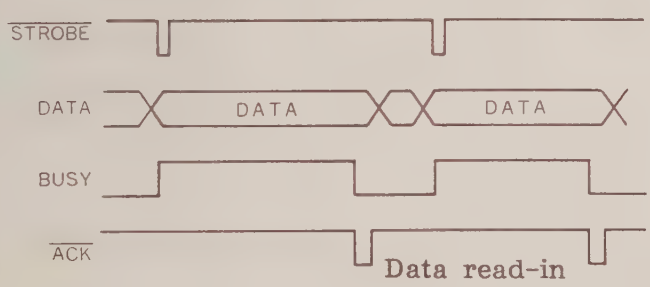
Always output a terminator at the end of character data. If this terminator is not appended, recording will not be made.

(d) Interface

The printer interface is an 8-bit parallel interface with the connector pin arrangement and signal protocol timing chart as follows.

B		A
BUSY	8	DATA0
$\overline{\text{ACK}}$	7	DATA1
N.C.	6	DATA2
GND	5	DATA3
GND	4	DATA4
$\overline{\text{BUSY}}$	3	DATA5
DATA7	2	DATA6
+5V	1	$\overline{\text{STROBE}}$

Printer Connector
Pin Arrangement



(e) Character Code Table

The printer code table is as follows.

Row / Column	00	…	02	03	04	05	…	11	12	13	…
0	NUL		SP	0	@	P		−	タ	ミ	
1	TC_1(SOH)		!	1	A	Q		ア	チ	ム	
2	TC_2(STX)		〃	2	B	R		イ	ツ	メ	
3	TC_3(ETX)		#	3	C	S		ウ	テ	モ	
4	TC_4(EOT)		$	4	D	T		エ	ト	ヤ	
5	TC_5(ENQ)		%	5	E	U		オ	ナ	ユ	
6	TC_6(ACK)		&	6	F	V		カ	ニ	ヨ	
7	BEL		'	7	G	W		キ	ヌ	ラ	
8	FE_0(BS)		(	8	H	X		ク	ネ	リ	
9	FE_1(HT)		)	9	I	Y		ケ	ノ	ル	
10	FE_2(LF)		*	:	J	Z		コ	ハ	レ	
11	FE_3(VT)		+	;	K	[		サ	ヒ	ロ	
12	FE_4(FF)		,	<	L	¥		シ	フ	ワ	
13	FE_5(CR)		−	=	M	]		ス	ヘ	ン	
14			.	>	N	↑		セ	ホ	゛	
15			/	?	O	←		ソ	マ	°	

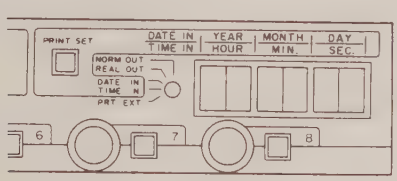
* All characters in the 00 column are treated as terminators.

1.4.8 Printer (External Mode B)

In the printer external mode B, a command given from an external device performs control. This command establishes whether or not selective recording is to be made of internal data and enables setting of the clock data as well. It is also possible to record character information from an external device.

(a) External Mode Operating Procedure

The external mode B settings are made as follows.



1 Set the STOP switch to STOP or set all HEAT switches to OFF.

2 Set the print mode switch to PRT. EXT.

3 Set the STOP switch to ON to begin recording.

4 Input a command from an external device.

Commands used to control the printer are as follows.

Printer Control Command Table

Command name	Command format	Function
DATA SET	DSxx,xx,xx CR/LF	Year/month/day clock setting
TIME SET	TSxx,xx,xx CR/LF	Hour/minute/second clock setting
PRINT FORMAT	PFn CR/LF (n=00 ∿ 15)	Print format setting
PRINT REPEAT LENGTH	PLn CR/LF (n=0 ∿ 3)	Print repeat interval setting
DATA NO. SET	DNn CR/LF (n=00 ∿ 99)	Data number setting
DATA NO. UP/DOWN	DMn CR/LF (n=0 ∿ 2)	Data number increment/decrement
LABEL	$LB_{C1 \sim C12}$ CR/LF	Label character string input
LABEL PRINT	LP CR/LF	Label printing

CAUTION

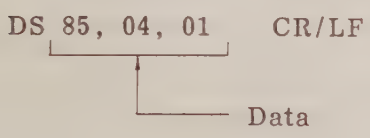
- Commands should be input using only upper-case ASCII characters. Refer to the command code table above.
- The data for commands DS and TS (indicated as x in the table) represents a numerical value. Dates up to the 31st are accepted for all months. Impossible values for month, hour, minute or second (Ex.: 13th month, 25:70:80 will be ignored).

The following is a description of each command.

o DATE SET

This command sets the year, month and day. Two-digit values are used for each data, these being separated by commas. The year is taken as the last two digits and this is automatically compensated for leap years.

(Example) April 1, 1985



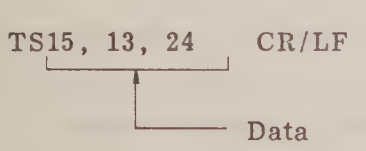
In BASIC, this would be as follows:

```
LPRINT"DS85,04,01"
```

o TIME SET

This command sets the hour, minute and second. Two-digit values are input for each data, these being separated by commas. The time should be input based on a 24-hour clock.

(Example) 15:13:24



o PRINT FORMAT

This command selects internal mode recording. The following selections of date, time, speed and data number are possible, depending upon the value of the input parameter. This parameter must be a two-digit value, and values of 16 or greater are ignored.

Parameter	Print format				Remarks
	Data	Time	Speed	No.	
00	-	-	-	-	Internal data not recorded.
01	-	-	-	○	
02	-	-	○	-	
03	-	-	○	○	
04	-	○	-	-	
05	-	○	-	○	
06	-	○	○	-	
07	-	○	○	○	
08	○	-	-	-	
09	○	-	-	○	
10	○	-	○	-	
11	○	-	○	○	
12	○	○	-	-	
13	○	○	-	○	
14	○	○	○	-	
15	○	○	○	○	

The default (initial value) is a parameter value n of 00.

(Example) Recording of time and speed.

P F 0 6 CR/LF

Parameter n

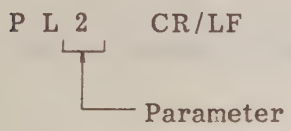
o PRINT REPEAT LENGTH

This command selects the repetition length for internal mode recording. The following lengths may be selected as shown in the table below, depending upon the value of the input parameter. The parameter must be input as a 1-digit value, and values of four or greater are ignored.

Parameter	Repetition length
0	Internal mode recording for each 450mm recording paper feed.
1	Internal mode recording for each 300mm recording paper feed.
2	Internal mode recording for each 200mm recording paper feed.
3	Internal mode recording for each 150mm recording paper feed.

The default (initial value) is a parameter n of 0.

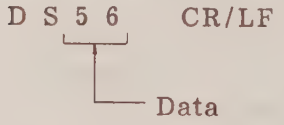
(Example) Recording every 200mm.



o DATA No. SET

This command sets the data number. This is input as a two-digit value.

(Example) Data number setting of 56.



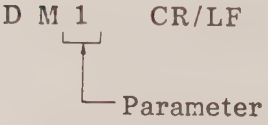
o DATA No. UP/DOWN

This command is used to increment and decrement the data number value. The following combinations are selectable, depending upon the value of the input parameter, with the data number changing automatically each time recording is made.

Parameter	Data number increment/decrement
0	Data number not changed.
1	Data number incremented by 1 (if the data number is 99, it changes to 00).
2	Data number decremented by 1 (if the data number is 00, it changes to 99).

The default (initial value) is a parameter n of 0.

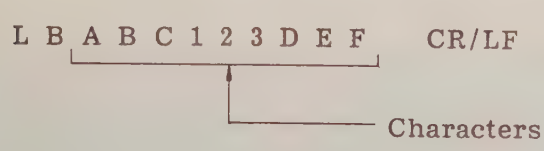
(Example) Data number changed from 56 to 57 (i.e., incremented).



o LABEL

This command inputs a character string to be recorded. These characters should be input as ASCII codes and the length should be a maximum of 12 characters. The 13th character and beyond will be ignored.

(Example) Recording of ABC123DEF



o LABEL PRINT

This command records a character string input using the LABEL command. If the LABEL PRINT command is not given, the character string will be written into memory but not recorded.

(Example) Recording of ABC123DEF

L B A B C 1 2 3 D E F CR/LF (Character input)

L P CR/LF (Execution of recording)

CAUTION

The LP command has higher priority than either the PF command or the PL command.

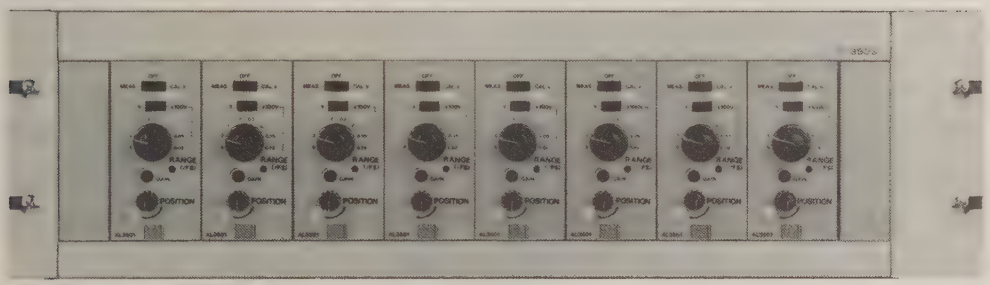
In effect, during a character recording using the LP command, if the position for PL command internal mode recording is

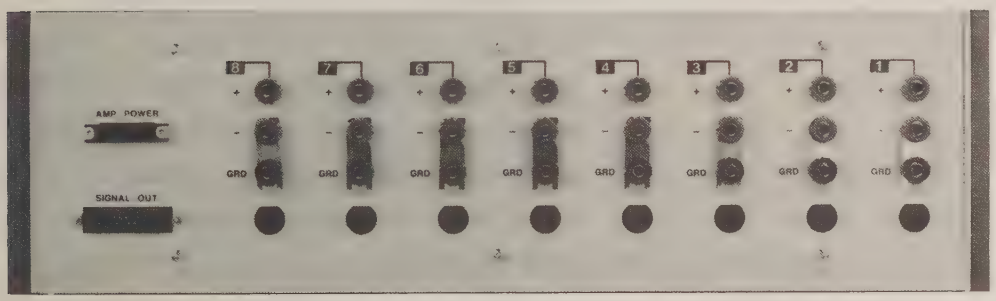
reached, the LP command character recording will continue. The internal mode will be recorded on the next PL command.

2. AMP BOX

2.1 Names and Functions of Parts

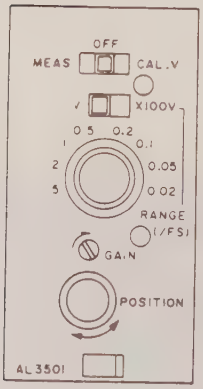
2.1.1 Amp Box Photograph





2.1.2 Amp Units

These are DC amplifiers used to amplify the level of low-level input signals. There are two types, which differ in sensitivity.



MEAS./OFF/CAL.

This switch is used to turn the input on and off and select the calibration voltage.

MEAS.: Pen deflects in accordance with the input signal.
OFF: Pen is separated from the input signal.
CAL.: A calibration voltage is input.

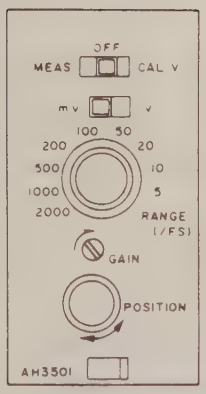
V/x100V

This multiplier switch is used to select either V or x100V as the units which apply to the RANGE setting. (For type H, this switch selects either mV or V units)

RANGE

This switch sets the pen deflection for a given input signal level. It is used in combination with the multiplier (V/x100V or mV/V) switch to establish the sensitivity in the range 0.02 ∿ 500V/full scale.

For type H, the sensitivity range is 5mV ∿ 500V/full scale. While this switch can be set in apparent range of 1000 ∿ 2000V/full scale, the actual input is limited to a maximum voltage of 500V. Take care that this limit is not exceeded.



GAIN

This is an amplitude adjustment which provides fine adjustment of sensitivity. It enables continuous adjustment between sensitivity ranges. With the MEAS/OFF/CAL switch set to CAL, a pen deflection of 1/2 of full scale corresponds to the RANGE sensitivity setting.

POSITION

This controls sets the zero point for the pen. Turning it CW moves the pen in the positive (left) direction.

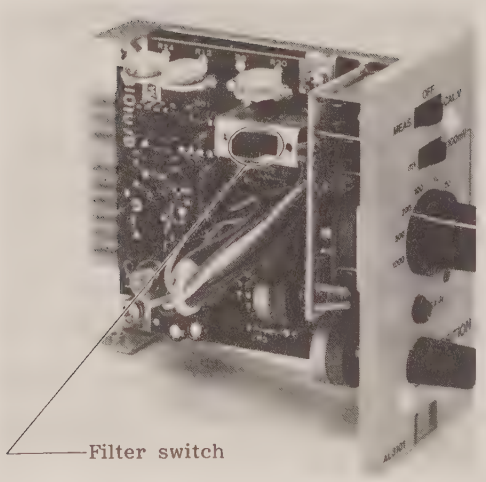
FILTER

This switch controls the filter which may be inserted to eliminate electrical noise (hum) which may be superimposed on the input signal.

OFF: The input signal is fed to the amplifier circuit without filtering.

-20dB: The filter operates with an attenuation of 1/10 at 50Hz.

-40dB: The filter operates with an attenuation of 1/100 at 50Hz.



2.1.3 Rear Panel Connection Section

AMP POWER

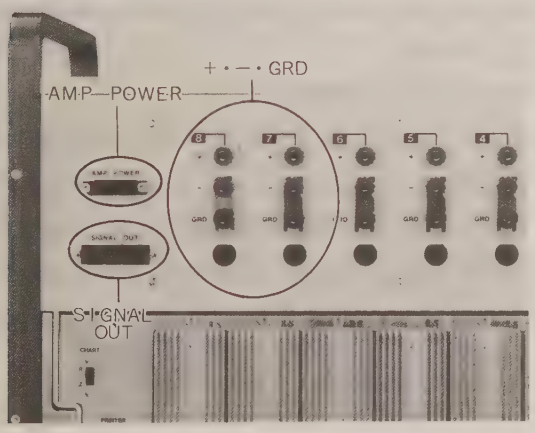
This is the amp unit power connector. Power is fed from the mainframe and connection is made using the special accessory cable provided.

SIGNAL OUT

This is the amp unit output connector. The amplified input signal is output at this connector. Make connection to it using the special accessory cable provided.

+ • - • GRD

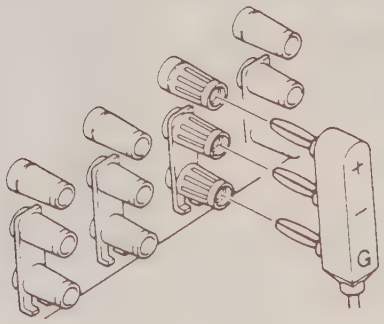
These are the input terminals for the signal to be measured. They consist of the positive (+), negative (-) and GUARD (GRD) terminals. All three terminals, it should be remembered, are floating from the cabinet (GND).



2.2 Signal Connections

2.2.1 Input Lines

The signal lines should, in general, be connected using the accessory input cable. This cable is a two-conductor, insulated shield cable with an input plug connected to it. It should be inserted as shown in the figure below, with the red lead connected to the (+) terminal, white lead connected to the (-) terminal and shield connected to the (GRD) terminal.



2.2.2 Inspection

When making signal connections, care should be taken with the following points.

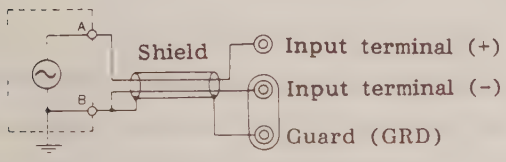
1 Set the amp unit MEAS/OFF/CAL switch to OFF.

2 Take care that a high frequency signal or voltage of 500V or greater is not applied between the signal source output and the protective ground terminal (GND) or input terminals (+), (-) or (GRD).

2.2.3 Connection

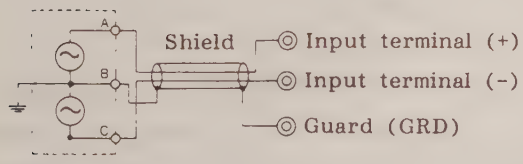
The proper connection method will depend upon the nature of the characteristics of the signal source.

(a) For a normal signal source, the connection should be made as shown in the figure below (with the shorting bar remaining connected).



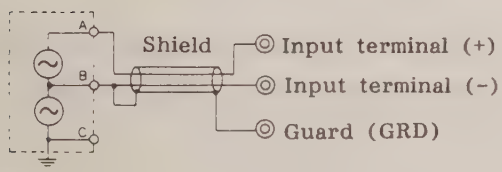
Signal source

(b) For signal sources which have a bias voltage, use the side having a low impedance with respect to ground as the (-), as shown below (with the shorting bar removed).



Signal source

(c) For signal sources having a differential output, make connections as shown below, with the side having a low impedance connected to (-) for this connection method as well (the shorting bar is removed).



Signal source

CAUTION

- When measuring low-level signals having a high output impedance, the connection method to the protective ground (GND), guard (GRD) and (-) terminal should be made to obtain the best noise rejection effect.

- When making input cable connections, reverse insertion of the connector can result in the shorting bar shorting the signal source output. Take care that this type of error is not made.

2.3 Measurement and Recording

2.3.1 Zero Setting

A zero setting adjustment (POSITION) is located on both the mainframe and the amp unit. When using the adjustment on the amp unit, set the POSITION adjustment on the mainframe as follows.

1 Feed the recording paper (i.e., with the STOP button not depressed).

2 Set the HEAT switches of all channels to OFF (i.e., not depressed).

3 Turn the POSITION of each channel to bring the pen positions to the center of the scale for each channel.

4 Set the HEAT switches for all channels to ON (depressed condition).

After the above is done, verify that the MEAS/OFF/CAL switch on the amp unit is set to OFF and turn the POSITION control on the amp unit to adjust the pen zero position.

2.3.2 Sensitivity Setting

Set the RANGE switch and V/x100V (or mV/V) switch to achieve the sensitivity required for the level of input signal to be recorded.

2.3.3 Fine Adjustment of Sensitivity

Set the MEAS/OFF/CAL switch to CAL and turn the GAIN adjustment while observing the pen deflection to fine adjust the sensitivity. With the pen deflected to one-half of full scale, the sensitivity is the RANGE switch setting.

The sensitivity is calculated as follows (for a 50-division recording).

$$\text{Sensitivity (V/FS)} = \frac{\text{25 Divisions}}{\text{No. of CAL divisions}} \times \text{RANGE value}$$

2.3.4 Starting Measurement

Once the above preparation has been performed, set the MEAS/OFF/CAL switch to MEAS to begin measurement.

CAUTION

- If the level of the input signal is unknown, start at low sensitivity (i.e., a high RANGE switch setting value) and gradually increase sensitivity.

- If an abnormal noise is heard or a pen is fully deflected during measurement, set the MEAS/OFF/CAL switch to OFF, disconnect the signal cable and check the input signal.

3. SPECIFICATIONS

3.1 Specifications

3.1.1 Mainframe Specifications

No. of channels	8	4
Pen motor	GS3501	GW3501
Recording width	±20mm	±40mm
Recording paper feed speed	5, 10, 20, 50, 100, 200, 500mm/s & min and external sync	
Feed accuracy	±0.2%±0.5mm	
Recording paper	Roll or Z-fold (length: 100m)	
Recording method	Thermal (black traces)	
Input type	Floating ground	
Input resistance	100kΩ, fixed	
Input sensitivity	F±2.5V/FS±0.5%	
Accuracy	±0.5% of full scale	
Position adjustment	Any position within full scale	
Frequency characteristics	40mm Amplitude 10mm p-p: 0 ∿ 140Hz 20mm p-p: 0 ∿ 100Hz 40mm p-p: 0 ∿ 60Hz +5%/-10%	80mm Amplitude 20mm p-p: 0 ∿ 60Hz 40mm p-p: 0 ∿ 45Hz 80mm p-p: 0 ∿ 30Hz +5%/-10%
Time marker	Marks every 1/10s or every 1/10min (switchable with the event marker)	
Event marker	Pushbutton or remote control operation (contact input or TTL-level signal)	
Recording paper feed stop	Pushbutton or remote control operation (contact input or TTL-level signal)	
Pen heat on/off	Pushbutton or remote control operation (contact input or TTL-level signal)	

No paper remaining warning	When paper runs out, a beeper alarm is sounded and recorder operation stops.	
Recording paper rewind	For roll paper only (5m), approx. 100mm/s	
Printing	Internal printing: Year/month/day, elapsed time or time, data number and feed speed External printing: ASCII Character string from external device	
Operating environment	0 ∿ +45°C, 30 ∿ 85% RH	
Power requirements	100/117/220/240VAC±10% (selectable), 50/60Hz	
Power consumption (approx.) (not balanced)	410VA	270VA
Outer dimensions (±3mm tolerance)		483(W) x 373.5(D) x 408.5(H) (not including handles)
Weight	37kg	32.2kg

3.1.2 Amp Unit Specifications

Input type	Floating with guard
Input resistance	1MΩ, fixed (allowable signal source resistance: 10kΩ or less)
Max. input voltage	500VDC (including common-mode voltage)
Measurement range (AL3501)	0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5V/FS 2, 5, 10, 20, 50, 100, 200, 500V/FS
Switching accuracy	±1%
Measurement range (AH3501)	5, 10, 20, 50, 100, 200, 500, 1000, 2000mV/FS 5, 10, 20, 50, 100, 200, 500V/FS
Switching accuracy	±1%
Sensitivity adjustment	Continuous between ranges
Position adjustment	Anywhere in the full scale range
Calibration voltage	x2 the range setting
Common-mode rejection ratio	DC: 130dB, AC: 110dB (AL3501) DC: 140dB, AC: 120dB (AH3501)
Input filtering (at 50Hz)	-40dB/-20dB/OFF

3.2 Accessories

Name	Qty.
Instruction manual	1
Recording paper (roll type)	1 roll
Input cables (2m long, with 3-pin plug)	8 (or 4)
Fuses	2
Vinyl cover	1
Accessory storage bag	1
Phillips screwdriver (3mm)	1
L Set-wrench (3mm)	1
Power cable	1
Remote connector	1
Connecting cables for mainframe and amp box	2

* For mainframe only:

- o An input connector is included and the input cables (8) and connecting cables (2) used between the mainframe and amp box are eliminated.

3.3 Supplies

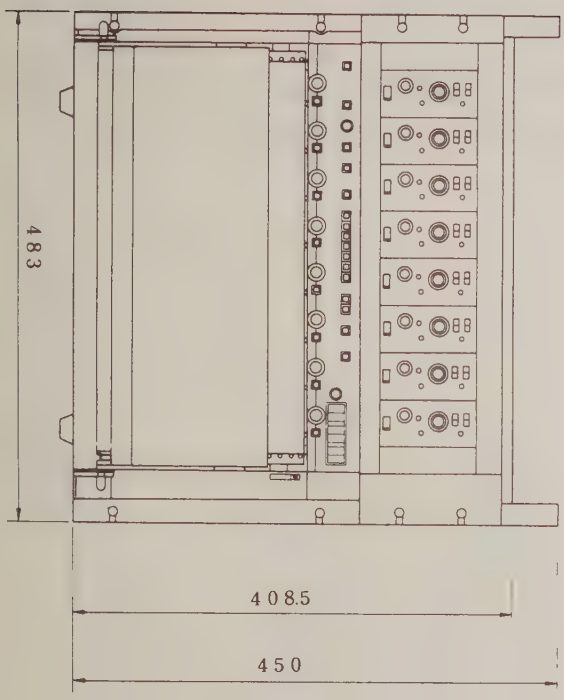
Recording Paper

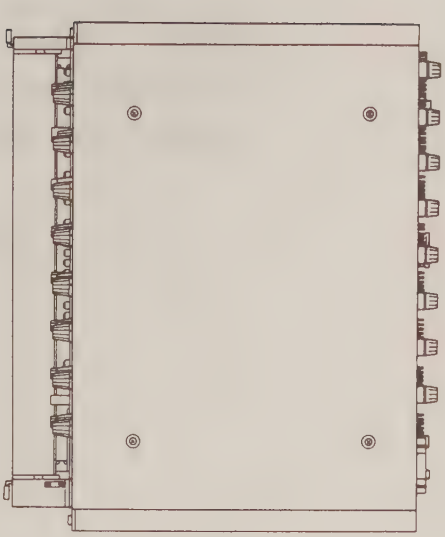
Model	Description
PR384-8B	Roll paper (100m)
PR389-4B	Roll paper (100m)
PZ384-8B	Z-Fold paper (150m)
PZ389-4B	Z-Fold paper (150m)

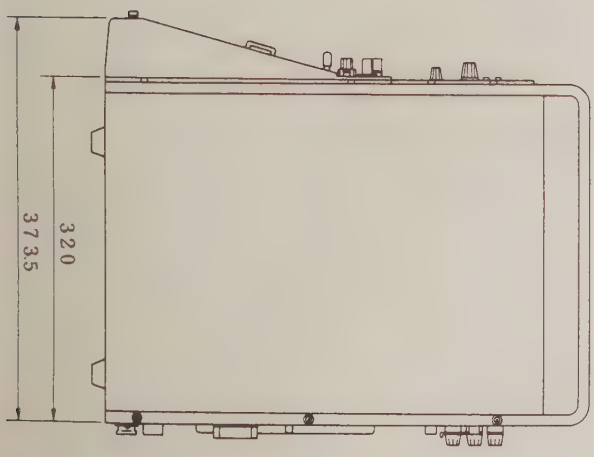
Recording Pens

Model	Description
KT201	Recording pen for GS3501 (40mm width)
KT202	Recording pen for GW3501 (80mm width)
KT204	Fine writing pen for GS3501 (40mm width)
KT205	Fine writing pen for GW3501 (80mm width)
KT203	Event marker pen

4. OUTER DIMENSIONS







5. INSPECTION CERTIFICATION

This product was manufactured under a strict program of quality control and has passed severe inspections. Inspections were performed at normal room temperature and humidity after the unit's circuitry was allowed to stabilize.

Inspector: _____

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